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(21) Application No 0304146.4	(51) INT CL ⁷ H04Q 7/38
(22) Date of Filing 25.02.2003	(52) UK CL (Edition V) H4L LDGR
(30) Priority Data (31) 02016742 (32) 27.03.2002 (33) KR	(56) Documents Cited WO 2002/017670 A1 WO 2001/099457 A1
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(54) Abstract Title
Handover of a mobile unit in a wireless local area network

(57) Disclosed in the present invention is a method for supporting mobility of a mobile node between subnetworks in a wireless local area network that includes a plurality of subnetworks networked through Internet and assigns a different Internet protocol (IP) address to the plural subnetworks, respectively, the method comprising the steps of: if the mobile node moves arbitrarily to a second subnetwork from a first subnetwork during communication, broadcasting a first message, in which a foreign mobile access server (MAS) of the second subnetwork includes the mobile node's medium access control (MAC) address; acquiring, at a home mobile access server of the first subnetwork, an address of the foreign mobile access server from the first message, and then transmitting a second message including an address of the home mobile access server and an Internet protocol address of the mobile node to the foreign mobile access server in reply to the first message; and routing, at the foreign mobile access server and the home mobile access server, the mobile node's data by using the other party's address.

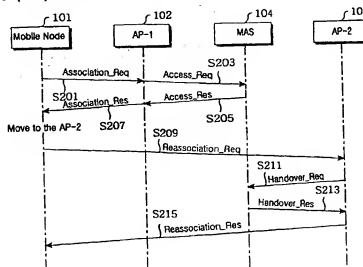


FIG.2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

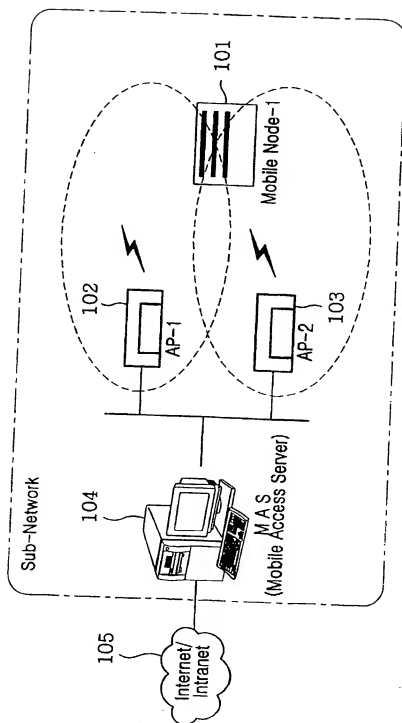


FIG.1

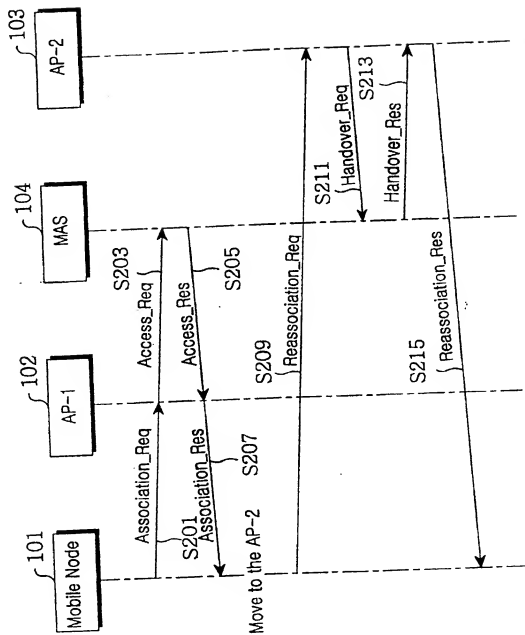


FIG.2

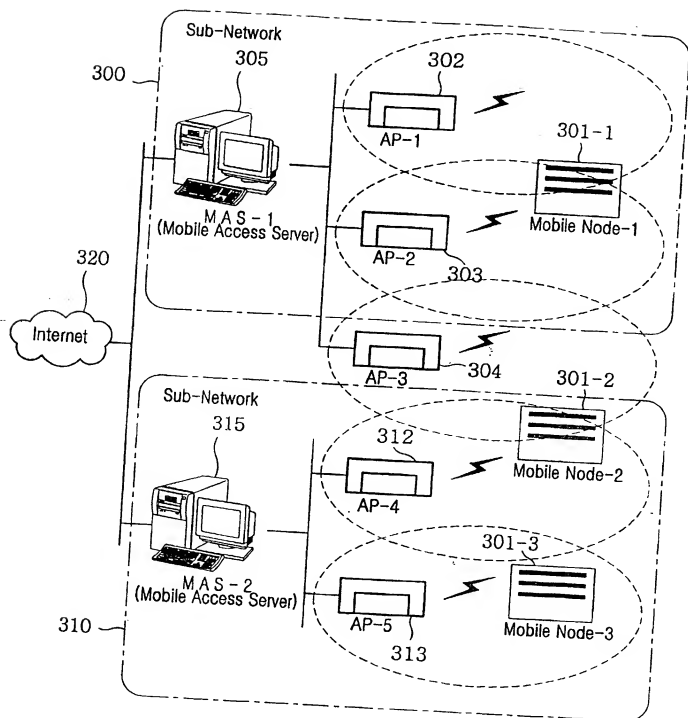


FIG.3

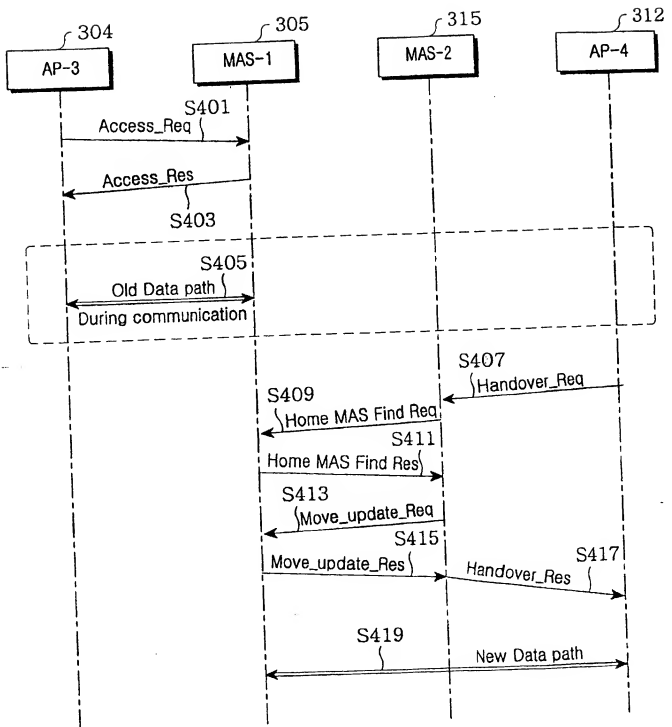


FIG.4

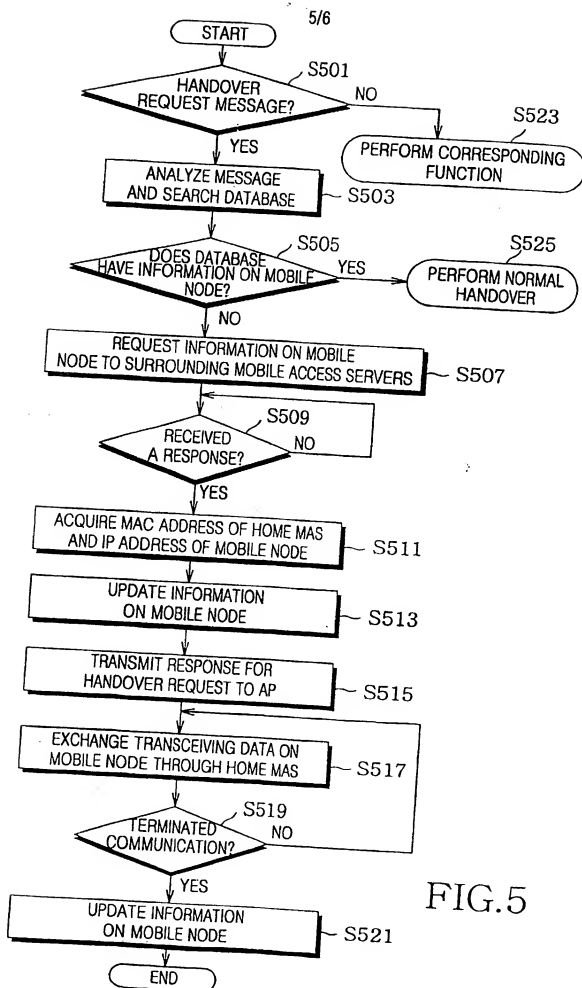


FIG.5

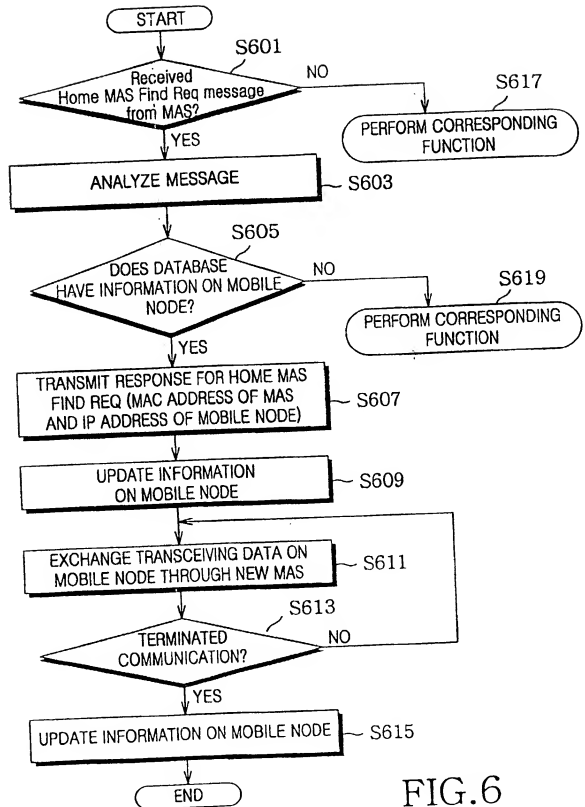


FIG.6

APPARATUS AND METHOD FOR SUPPORTING MOBILITY BETWEEN
SUBNETWORKS OF MOBILE NODE IN WIRELESS LAN

The present invention relates generally to wireless
5 local area network (WLAN), and more particularly, though
not exclusively, to an apparatus and a method for
supporting mobility of a mobile node between foreign
subnetworks in the local area network.

10 By way of explanation a subnetwork will be
hereinafter presumed to be a small network unit that is
divided by a gateway in a private network. Typically, a
mobility of a mobile node is supported within the same
subnetwork only, and the applied technology thereof has
15 been supported by using medium access control (MAC) level
data on Ethernet or 802.3, but not through mobility
support on IP (Internet Protocol).

It will be understood that a mobile node in a
20 wireless local area network can correspond to a mobile
computer such as a notebook computer, laptop computer,
tablet computer, hand-held computer, wearable computer,
or other type of portable computer device. Also, a
mobile node in a wireless local area network can
25 correspond to a mobile telephone, a pager, a text-
messaging device, a communication unit such as a
semiconductor chip for communications, or other type of
portable communication apparatus.

30 Furthermore a mobile node can correspond to any unit
that can be in communication with a wireless network. A
mobile node may be known by many different names, such as
mobile terminal, mobile computing device, mobile station,

remote unit, mobile unit, or a mobile user station, for example.

5 A mobile node communicates with a wireless local area network (WLAN) using a network interface card (NIC). Access points manage wireless resources in a subnetwork of a wireless local area network. The access points exchange information with a mobile node through a wireless link. A mobile access server controls access
10 points, and supports signal protocol, for example, call set and call release. A mobile access server (MAS) includes a gateway for communication with Internet and/or Intranet.

15 Likewise there is currently a lack of convenient and efficient support for a mobility of a mobile node. Efforts have been made to improve features related to mobile terminals.

20 Exemplars of recent efforts in the art are disclosed, for example, in U.S. Patent No. 6,447,156 to Ala-Laurila et al., entitled APPARATUS AND ASSOCIATED METHOD FOR SELECTABLY OPERATING RADIO DEVICE I ALTERNATE
25 No. 6,473,413 to Chiou et al., entitled METHOD FOR INTER-IP-DOMAIN ROAMING ACROSS WIRELESS NETWORKS, issued on October 29, 2002, U.S. Patent No. 6,360,264 to Rom, entitled METHOD AND APPARATUS FOR MAINTAINING
30 CONNECTIVITY OF NODES IN A WIRELESS LOCAL AREA NETWORK, issued on March 19, 2002, U.S. Patent No. 6,188,681 to Vesuna, entitled METHOD AND APPARATUS FOR DETERMINING ALTERNATIVE SECOND STATIONARY ACCESS POINT IN RESPONSE TO DETECTING IMPEDED WIRELESS CONNECTION, issued on February 13, 2001, U.S. Patent No. 6,061,563 to Lee, entitled

METHOD OF MOVING STATION IN WIRELESS LAN, issued on May 9, 2000, U.S. Patent No. 6,006,090 to Coleman et al., entitled PROVIDING ROAMING CAPABILITY FOR MOBILE COMPUTERS IN A STANDARD NETWORK, issued on December 21, 5 1999, and U.S. Patent No. 5,724,346 to Kobayashi et al., entitled MEANS FOR MAINTAINING CONNECTABLE ACCESS POINTS OWING TO MOVEMENT OF A MOBILE STATION BETWEEN CELLS IN A WIRELESS LAN SYSTEM, issued on March 3, 1998.

10 While these contemporary efforts contain merit/significance/value further improvements would be advantageous.

Some products may support mobility in the same 15 subnetwork. That is, some products may support handover between access networks in the one network using the same gateway. However, some such products do not provide an adequately improved method and apparatus for conveniently and efficiently supporting mobility between foreign 20 subnetworks.

In an attempt to discuss and solve the problem related to a handoff from one subnetwork to a different subnetwork, "Mobile IPv4" could be considered. "Mobile 25 IPv4" is mobile Internet protocol, version 4. However, the mobile node should be supported with mobility as well, in order to support the "Mobile IPv4". That is, the "Mobile IPv4" cannot be used in the absence of support for the mobile node. Another possible problem 30 concerned here is that it takes too much time to convert the data path because the mobile access server should have a "Mobile Agent" including home agent (HA)/foreign agent (FA) to support mobility, and a tunnelling structure should be implemented between those two agents.

Hence, a new, improved, convenient, and efficient scheme for supporting mobility of a mobile node between foreign subnetworks is needed, which does not have to be as complicated as the "Mobile IPv4" or changing the mobile node.

Furthermore it is known that it can be difficult, inconvenient, inefficient and/or unnecessarily complicated to move a mobile node between subnetworks of a wireless local area network.

It is an aim of embodiments of the present invention to at least partly mitigate the above-referenced problems.

According to a first aspect of the present invention there is provided a method of communication for a mobile node, the method comprising:

moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being subnetworks in a wireless local area network, the first and second subnetworks being networked to each other through the Internet, the first subnetwork being assigned a first Internet protocol address, the second subnetwork being assigned a second Internet protocol address different from the first Internet protocol address;

broadcasting a first message from a second mobile access server of the second subnetwork, the first message including a medium access control address of the mobile node;

acquiring an address of the second mobile access server from the first message, said acquiring being performed by a first mobile access server of the first subnetwork;

transmitting a second message from the first mobile access server to the second mobile access server in response to the first message, the second message including an address of the first mobile access server and an Internet protocol address of the mobile node; and
5 when the mobile node is in the second subnetwork, routing first data from the mobile node through the second mobile access server and then through the first mobile access server.

10

According to a second aspect of the present invention there is provided a handover processing method for a mobile node, the method comprising:

moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being subnetworks in a wireless local area network, the first and second subnetworks being networked to each other through the Internet and the first and second subnetworks not being assigned the same Internet protocol address;

20 transmitting a handover request message from an access point of the second subnetwork to a second mobile access server of the second subnetwork, the handover request message including a medium access control address of the mobile node;

25 broadcasting a first message from the second mobile access server in response to the handover request message, the first message including a medium access control address of the mobile node;

when a second message is received in response to the first message, acquiring an address of a first mobile access server of the first subnetwork and an Internet protocol address of the mobile node from the second message; and
30

when the mobile node is in the second subnetwork,
routing data from the mobile node through the address of
the first mobile access server.

5 According to a third aspect of the present invention
there is provided a handover processing method for a
mobile node, the method comprising:

10 moving a mobile node from a first subnetwork to a
second subnetwork, the first and second subnetworks being
subnetworks in a wireless local area network, the first
and second subnetworks being networked to each other
through the Internet and the first and second subnetworks
not being assigned the same Internet protocol address;

15 receiving a first message at a first mobile access
server of the first subnetwork, the first message
including an address of the first mobile node;

20 acquiring an address of a second mobile access
server of the second subnetwork from the first message
received, said acquiring being performed by the first
mobile access server;

25 transmitting a second message to the second mobile
access server in dependence upon said acquiring of the
address of the second mobile access server, the second
message including an address of the first mobile access
server and an Internet protocol of the mobile node; and
30 routing data from the mobile node through the
address of the second mobile access server acquired by
the first mobile access server.

30 According to a fourth aspect of the present
invention there is provided an apparatus for mobile
communication, the apparatus comprising:

35 a first subnetwork being in a wireless local area
network, being in communication with the Internet, and
being assigned a first Internet protocol address;

a second subnetwork being in the wireless local area network, being in communication with the Internet, and being assigned a second Internet protocol address different from the first Internet protocol address;

5 a foreign mobile access server being mounted in said second subnetwork and broadcasting a first message including a medium access control address of a mobile node when the mobile node moves to said second subnetwork from said first subnetwork; and

10 a home mobile access server being mounted in said first subnetwork, acquiring an address of said foreign mobile access server from the first message, said home mobile access server transmitting a second message in response to the first message, the second message including an address of said home mobile access server and an Internet protocol address of the mobile node to
15 said foreign mobile access server; wherein

said foreign mobile access server is arranged to route first data from the mobile node to the home mobile
20 access server; and

said home mobile access server is arranged to route second data through the foreign mobile access server and then to the mobile node.

25 Embodiments of the present invention provide an improved apparatus and method that enables a mobile node to be conveniently moved from a first subnetwork in a wireless local area network (WLAN) to a second subnetwork in the wireless local area network.

30 Embodiments of the present invention provide an apparatus and a method for supporting mobility of a mobile node between foreign subnetworks within a wireless local area network.

Embodiments of the present invention provide a method for supporting mobility of a mobile node between subnetworks in a wireless local area network that includes a plurality of subnetworks networked through Internet and assigns a different Internet protocol (IP) address to each of the plural subnetworks, the method comprising: when the mobile node moves arbitrarily to a second subnetwork from a first subnetwork during communication, broadcasting a first message, in which a foreign mobile access server (MAS) of the second subnetwork includes the mobile node's medium access control (MAC) address or/and previous access point address; acquiring, at a home mobile access server of the first subnetwork, an address of the foreign mobile access server from the first message, and transmitting a second message including an address of the home mobile access server and an Internet protocol address of the mobile node to the foreign mobile access server in reply to the first message; and routing, at the foreign mobile access server and the home mobile access server, the mobile node's data by using the other party's address.

The present invention is more specifically described in the following paragraphs by reference to the drawings attached only by way of example. Other advantages and features will become apparent from the following description and from the claims.

In the accompanying drawings, which are incorporated in and constitute a part of this specification, embodiments of the invention are illustrated, which, together with a general description of the invention given above, and the detailed description given below, serve to exemplify the principles of this invention.

Fig. 1 is a schematic diagram of a lower subnetwork
in an exemplary wireless local area network;

Fig. 2 depicts an exemplary flow of supporting
5 mobility within one subnetwork in a wireless local area
network;

Fig. 3 is a schematic diagram of a wireless local
area network including a plurality of subnetworks, in
10 accordance with the principles of the present invention;

Fig. 4 diagrammatically depicts signal messages that
are exchanged between components when a mobile node moves
to a foreign subnetwork from home subnetwork in the
15 wireless local area network, in accordance with the
principles of the present invention;

Fig. 5 is a flow chart illustrating handover that is
performed by a foreign mobile access server (MAS), in
20 accordance with the principles of the present invention;
and

Fig. 6 is a flow chart illustrating handover that is
performed by a home mobile access server, in accordance
25 with the principles of the present invention.

While the present invention will be described more
fully hereinafter with reference to the accompanying
drawings, in which details of the present invention are
30 shown, it is to be understood at the outset of the
description which follows that persons of skill in the
appropriate arts may modify the invention here described
while still achieving the favourable results of this
invention. Accordingly, the description which follows is
35 to be understood as being a broad, teaching disclosure

directed to persons of skill in the appropriate arts, and not as limiting upon the present invention.

Illustrative embodiments of the invention are described below. In the interest of clarity, not all features of an actual implementation are described. In the following description, well-known functions, constructions, and configurations are not described in detail since they could obscure the invention with unnecessary detail.

Fig. 1 depicts the configuration of a lower subnetwork in an exemplary wireless local area network. The subnetwork includes a mobile node 101, access points (AP) 102 and 103, and a mobile access server (MAS) 104. Referring to Fig. 1, mobile node 101 indicates a mobile node that is in communication with a wireless local area network (WLAN) through the use of a network interface card (NIC). Access points 102, 103 manage wireless resources, and practically, exchange information with a mobile node through a wireless link. Mobile access server 104 controls access points, and supports signal protocol, for example, call set and call release. Moreover, the mobile access server 104 includes a gateway (not shown) for communication with Internet/Intranet 105.

A mobile node can be handed off from a first access point 102 to a second access point 103 in the one subnetwork having the above-described configuration. However, the mobile node cannot be handed off to a different subnetwork. The flow or procedure for supporting mobility within the same one subnetwork is depicted in Fig. 2. Namely, Fig. 2 is a flow chart of a handover procedure concerned in a case where a mobile node moves from the first access point's service area to

the second access point's service area, in one subnetwork.

Referring to Fig. 2, at step S201, the mobile node
5 101 transfers an association request message
(Association_Req) to a first access point 102 for
communication with the first access point 102. Then, at
step S203, the first access point 102 transfers an access
request message (Access_Req) to the mobile access server
10 104 to inform that the mobile node wants an association.
Having received the Access_Req, the mobile access server
104 confirms whether a location move request message for
the mobile node is normal, and updates the location data
related to the mobile node and then updates a service-
15 pass (message routing information) for the mobile node,
thereby performing data transmission concerning the
mobile node. At step S205, the mobile access server 104
sends an access response message (Access_Res) to the
first access point 102 in reply to the Access_Req. At
20 step S207, the first access point 102 transmits an
association response message (Association_Res) to the
mobile node 101 in reply to the Association_Req. Once
the association is set in such manner, the mobile node
101 performs communication through the first access point
25 102.

If the mobile node moves to another access point,
that is, a second access point, that is within the same
one subnetwork, the mobile node 101 concludes that the
30 signal intensity of the first access point has been
weakened, and scans another new access point until it
acquires a signal of the second access point 103. At
step S209, the mobile node 101 transmits a reassociation
request message (Reassociation_Req) to the second access
35 point 103, and the second access point 103 transmits a

handover request message (Handover_Req) to the mobile
access server 104. Then, the mobile access server 104
updates data on location registration
(Location_registration) of the mobile node, and changes
5 the data path to the mobile node, namely from the first
access point to the second access point. At step S211,
the second access point 103 transmits a handover request
message (Handover_Res). At step S213, the mobile access
server 104 transmits a handover response message
10 (Handover_Res) to the second access point 103 in reply to
the Handover_Req. Later, at step S215, the second access
point 103 sends a reassociation response message
(Reassociation_Res) to the mobile node 101 to notify that
the handover has been completed. In this way, the
15 handover is duly completed, and the mobile node 101 can
perform communication through the second access point
103.

Described below is a manner for supporting mobility
20 of a mobile node between foreign subnetworks within a
private network, for example, a wireless local area
network in accordance with an embodiment of the present
invention. Here, the term "subnetwork" means a small
network unit that is divided by a gateway. Here, a
25 mobile node can communicate with a second node through
the Internet. Here, the second node, also known as a
communication node, can be any node or terminal or unit
that is connected to the Internet and that is in
communication with the mobile node. When data is sent
30 from the mobile node to the communication node, the
communication node is the destination node. When data is
sent from the communication node to the mobile node, the
communication node is the origination node.

Fig. 3 is a schematic diagram of a wireless local area network including a plurality of subnetworks, in accordance with the principles of the present invention. As shown in the drawing, a first subnetwork 300 includes a first access point (AP) 302, a second access point 303, a third access point 304, and a first mobile access server (MAS) 305. A second subnetwork 310 includes a fourth access point 312 and a fifth access point 313. Here, the first mobile access server 305 and the second mobile access server 315 are networked through the Internet 320.

The mobile nodes 301-1, 301-2, and 301-3 indicate mobile nodes mounted with a wireless local area network using network interface card (NIC). The access points 302, 303, 304, 312, and 313 manage wireless resources, and practically exchange information with mobile nodes through a wireless link. The access points basically support bridge function between a wired local area network and a wireless local area network, and forward request messages from a mobile node to a mobile access server (MAS).

Mobile access server 305 controls the first access point 302, the second access point 303, and the third access point 304. Another mobile access server 315 controls the fourth access point 312 and the fifth access point 313. Here, the mobile access servers 305 and 315 support a plurality of protocols (call setup, call release, mobility, management, and security), and manage information on the access points and the mobile node, and perform data path switching and Internet protocol assignment. Also, the mobile access servers 305 and 315 include a gateway (not shown) for communicating with Internet 320.

The following explains the operation based on the above-described constitution. Fig. 4 diagrammatically depicts signal messages that are exchanged between components when a mobile node moves to a foreign subnetwork from home subnetwork in the wireless local area network, in accordance with the principles of the present invention. Fig. 4 shows handover procedure, or flow, when a mobile node moves from the third access point 304 service area of the first subnetwork 300 to the fourth access point 312 service area of the second subnetwork 310.

The first mobile access server 305 can be referred to as the home mobile access server 305. The second mobile access server 315 can be referred to as the foreign mobile access server 315.

At step S401, with reference to Fig. 4, the third access point 304, having received an association request from the mobile node 301-2, transmits an access request message (Access_Req) to the first mobile access server 305 for notifying that the mobile node 301-2 has requested an association. After receiving the Access_Req, the first mobile access server 305 updates management data for communicating, and allows the service to the mobile node. And, at step S403, the first mobile access server 305 transmits an access response (Access_Res) to the third access point 304 in reply to the Access_Req. Then, the third access point 304 transmits a response to the Association_Req to the mobile node 301-2. At step S405, when the association is set, the mobile node 301-2 performs communication through the third access point 304 and the first mobile access server 305.

If the mobile node 301-2 moves to the service area of the fourth access point 312 while communicating with a second node or communication node through the Internet
5 320, the mobile node 301-2 concludes that the signal intensity of the third access point 304 has been weakened, and scans for another access point until it acquires a signal of the fourth access point 312. The mobile node 301-2 transmits a reassociation request
10 message (Reassociation_Req) to the fourth access point 312. At step S407, the fourth access point 312 transmits a handover request message (Handover_Req) from the mobile node 301-2 to the second mobile access server 315.

15 The Handover_Req includes a physical address, for example, medium access control (MAC) address, and/or the Internet protocol address of the third access point 304 for identifying the mobile node 301-2. The second mobile access server 315, having received the Handover_Req,
20 checks to determine whether the information on the mobile node 301-2 is stored in its own database.

At step S409, when it turns out that there is no such information, the second mobile access server 315
25 broadcasts Home mobile access server (MAS) Find request message to surrounding mobile access servers (for example, the first mobile access server 305) to acquire the Internet protocol address of the mobile node 301-2. An arbitrarily defined protocol can be used for the Home
30 mobile access server (MAS) Find request message broadcast from the second mobile access server 315. Also, reverse address resolution protocol (RARP) can be used for the Home mobile access server (MAS) Find request message
35 reverse address resolution protocol (RARP) maps a

hardware address, such as a medium access control address, to an Internet address.

5 The Home mobile access server (MAS) Find request message broadcast from the second mobile access server 315 can include the medium access control (MAC) address of the mobile node 301-2. At step S411, the first mobile access server 305 that received the Home mobile access server (MAS) Find request message transfers a Home mobile
10 access server (MAS) Find response message including the medium access control (MAC) address and Internet protocol address of the first mobile access server 305 to the second mobile access server 315. At this point, the second mobile access server 315 acquires the medium
15 access control (MAC) address and Internet protocol address of the Home mobile access server (MAS) 305, and the Internet protocol address of the mobile node 301-2.

At step S413, to update the information for
20 supporting mobility, the second mobile access server 315 requests the first mobile access server 305 to update the information for supporting mobility. At step S415, the first mobile access server 305 responds to the update request.

25 In this way, information in connection with authentication between mobile access servers 305 and 315 and the mobile node 301-2, which are required for mobility, can be updated. At step S417, the second
30 mobile access server 315 transmits a response message to the fourth access point 312 in reply to the Handover_Req, and terminates the handover. At step S419, once the handover is terminated, the mobile node 301-2 performs communication through the fourth access point 312, the

one mobile access server 315, and the first mobile access server 305 on the newly established data path.

When the Mobile Access Server 315 receives a handover request that is performed by a foreign mobile access server (MAS), in accordance with the present invention, the foreign mobile access server (MAS) 315 and the mobile access server 305 have a new association to which the mobile access server 305 is a mobile access server, and the Home mobile access server 305 is a mobile access server. The Home mobile access server 305 has an initial association request.

At step 5501, with reference to Fig. 5, the foreign mobile access server (MAS) 315 receives a handover request from a lower access point. At step 5502, when the Handover Req has not been received, the foreign mobile access server 315 performs a relevant or appropriate function corresponding to the circumstances. At step 5503, when the Handover Req has been received, the foreign mobile access server 315 analyzes the Handover Req received from the access point. At step 5505, the foreign mobile access server 315, in accordance with the present invention, receives the Handover Req.

The mobile access server 305 is located in the Handover Req, and the mobile access server 305 is located in its own database. At step 5525, if the information exists, the foreign mobile access server 315 performs a normal handover. At step 5507, however, if there is no such information, the foreign mobile access server 315 broadcasts a Home mobile access server (MAS) find request message for surrounding mobile access servers. The Home mobile access server 305, for example, receives the find request message from the mobile access server 315.

At step S509, after broadcasting the Home mobile access server (MAS) Find request message, the foreign mobile access server 315 checks to determine whether a response message to the Home mobile access server (MAS) Find request message has been received. At step S511, if the Home mobile access server (MAS) Find request message has been received, the foreign mobile access server 315 acquires the medium access control (MAC) address and Internet protocol address of the Home mobile access server 305, and also acquires the Internet protocol address of the mobile node 301-2 from the response message.

Afterwards, the foreign mobile access server 315 requests the Home mobile access server to update information on the mobile node's location/route. At step S513, the foreign mobile access server 315 updates information in the database in connection with authentication between mobile access servers 305 and 315 and the mobile node 301-2 that are required for mobility.

At step S515, after updating the information for supporting mobility, the foreign mobile access server 315 transmits a response message (that is, Handover_Res) to the fourth access point 312 in reply to the Handover_Req to terminate the handover. At step S517, transceiving data is exchanged on mobile node 301-2 through home MAS 305. That is, at step S517, once the handover is terminated, the foreign mobile access server 315 exchanges transceiving data for the mobile node 301-2 through the Home mobile access server 305.

When the mobile node 301-2 was in the area of the first subnetwork 300, the mobile node 301-2 had established a communication path with a second node or

communication node, the communication node was connected to the Internet 320, and data was being transmitted from the mobile node 301-2 through the access point 304, the home mobile access server 305, the Internet 320, and to the communication node. Also, data was being transmitted from the communication node through the Internet 320, the home mobile access server 305, the access point 304, and to the mobile node 301-2.

At step S517, the mobile node 301-2 has been moved to the area of the second subnetwork 310, the mobile node 301-2 has established a new communication path with the communication node, the communication node is still connected to the Internet 320, and data is being transmitted from the mobile node 301-2 through the access point 312, the foreign mobile access server 315, the home mobile access server 305, the Internet 320, and to the communication node. Also, data is being transmitted from the communication node through the Internet 320, through the home mobile access server 305, through the foreign mobile access server 315, through the access point 312, and to the mobile node 301-2.

The transmitted data from the mobile node 301-2 is sent to the other party or destination node, also known as the communication node, through the fourth access point 312, the foreign mobile access server 315, and the Home mobile access server 305. And, the data being transmitted from the other party or communication node is sent back to the mobile node 301-2 through the Home mobile access server 305, the foreign mobile access server 315, and the fourth access point 312.

Later, at step S519, the foreign mobile access server 315 checks to determine whether the communication

for the mobile node 301-2 has been terminated. At step S521, when the communication for the mobile node 301-2 has been terminated, the foreign mobile access server 315 updates information on the mobile node 301-2 that has been stored in the database, and the whole procedure is finished here.

Fig. 6 is a flow chart illustrating handover that is performed by a home mobile access server, in accordance with the principles of the present invention. With reference to Fig. 6, at step S601, the Home mobile access server (MAS) 305 checks to determine whether the Home mobile access server (MAS) Find Request, requesting the Internet protocol address of a particular mobile node, has been received from an arbitrary mobile access server (MAS) through the Internet 320.

At step S617, when the Home mobile access server (MAS) Find Request message has not been received, the Home mobile access server 305 performs a function corresponding to the circumstances. At step S603, when the message has been received, the Home mobile access server 305 analyses the received message and, based on this analysis, it acquires the physical address, that is, the medium access control (MAC) address, for identifying the particular mobile node and also information on the server that transmitted the Home mobile access server Find Request message, that is, the medium access control (MAC) address, the Internet protocol address, and other information. As mentioned before, the particular mobile node is presumed to be the mobile node 301-2.

At step S605, based on the medium access control (MAC) address of the mobile node 301-2 obtained at step S603, the Home mobile access server 305 checks to

determine whether there is information on the mobile node 301-2 in its own database. At step S619, when there is no such information, the Home mobile access server 305 performs a corresponding function appropriate for the
5 circumstances.

At step S607, when there is the information on the mobile node 301-2, the Home mobile access server 305 acquires the mobile node's Internet protocol address from the database, and generates a response to the Home mobile
10 access server Find Request, and transmits the response. Here, the response message includes information on the Internet protocol address of the mobile node 301-2 and the medium access control (MAC) address of the Home
15 mobile access server.

At step S609, later, the Home mobile access server 305 updates the information for supporting mobility of the mobile node 301-2 at the request of the foreign
20 mobile access server 315. In other words, the Home mobile access server 305 updates the mobile node's location registration information.

At step S611, the Home mobile access server 305 exchanges transceived data on the mobile node 301-2 through the foreign mobile access server 315. More specifically, the transmitted data from the mobile node 301-2 is sent to the other party, also referred to as the communication node, through the fourth access point 312,
25 the foreign mobile access server 315, and the Home mobile access server 305, and the data being transmitted from the other party is sent back to the mobile node 301-2 through the Home mobile access server 305, the foreign
30 mobile access server 315, and the fourth access point 312.
35

At step S613, the foreign mobile access server 315 checks to determine whether the communication for the mobile node 301-2 has been terminated. At step S615, 5 when the communication has been terminated between the mobile node 301-2 and the communication node, the Home mobile access server 305 updates information on the mobile node 301-2 in the database, and ends the whole procedure.

10 In conclusion, embodiments of the present invention introduce a method for supporting a mobile node's mobility through access points and mobile access servers only, without using a complicated protocol or making 15 additional changes in the mobile node. In addition, embodiments of the present invention advantageously changes a data routing path to a new access point by figuring out the motion of the mobile node at a medium access control layer.

20 While the present invention has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or 25 in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, representative apparatus and 30 method, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the scope of the general inventive concept.

CLAIMS:

1. A method of communication for a mobile node, the method comprising:

5 moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being subnetworks in a wireless local area network, the first and second subnetworks being networked to each other through the Internet, the first subnetwork being assigned a first Internet protocol address, the second subnetwork
10 being assigned a second Internet protocol address different from the first Internet protocol address;

broadcasting a first message from a second mobile access server of the second subnetwork, the first message
15 including a medium access control address of the mobile node;

acquiring an address of the second mobile access server from the first message, said acquiring being performed by a first mobile access server of the first
20 subnetwork;

transmitting a second message from the first mobile access server to the second mobile access server in response to the first message, the second message
25 including an address of the first mobile access server and an Internet protocol address of the mobile node; and when the mobile node is in the second subnetwork, routing first data from the mobile node through the second mobile access server and then through the first mobile access server.

30 2. The method of claim 1, wherein the first message conforms to a reverse address resolution protocol.

35 3. The method of claim 1, further comprising:

routing second data through the first mobile access server and then through the second mobile access server and then to the mobile node.

5 4. The method of claim 1, wherein said broadcasting of the first message is performed when the mobile node is communicating with a second node during said moving.

10 5. The method of claim 4, wherein the first data is routed to the second node after being routed through the first mobile access server.

15 6. The method of claim 5, further comprising:
when the mobile node is in the second subnetwork,
routing second data from the second node through the first mobile access server and then through the second mobile access server and then to the mobile node.

20 7. The method of claim 6, wherein the first message conforms to a reverse address resolution protocol.

25 8. The method of claim 7, wherein the first subnetwork and the first mobile access server correspond to a home subnetwork and a home mobile access server respectively, and the second subnetwork and the second mobile access server correspond to a foreign subnetwork and a foreign mobile access server respectively.

30 9. A handover processing method for a mobile node, the method comprising:
moving a mobile node from a first subnetwork to a second subnetwork, the first and second subnetworks being
35 subnetworks in a wireless local area network, the first

and second subnetworks being networked to each other through the Internet and the first and second subnetworks not being assigned the same Internet protocol address;

transmitting a handover request message from an
5 access point of the second subnetwork to a second mobile access server of the second subnetwork, the handover request message including a medium access control address of the mobile node;

broadcasting a first message from the second mobile
10 access server in response to the handover request message, the first message including a medium access control address of the mobile node;

when a second message is received in response to the first message, acquiring an address of a first mobile;
15 access server of the first subnetwork and an Internet protocol address of the mobile node from the second message; and

when the mobile node is in the second subnetwork, routing data from the mobile node through the address of
20 the first mobile access server.

10. The method of claim 9, wherein said transmitting of the handover request message is performed when the mobile node is communicating with a second node
25 during said moving.

11. The method of claim 10, wherein the data is routed to the second node after being routed through the first mobile access server.
30

12. The method of claim 11, wherein the first message conforms to a reverse address resolution protocol.

13. A handover processing method for a mobile node,
the method comprising:

moving a mobile node from a first subnetwork to a
second subnetwork, the first and second subnetworks being
5 subnetworks in a wireless local area network, the first
and second subnetworks being networked to each other
through the Internet and the first and second subnetworks
not being assigned the same Internet protocol address;

receiving a first message at a first mobile access
10 server of the first subnetwork, the first message
including an address of the first mobile node;

acquiring an address of a second mobile access
server of the second subnetwork from the first message
received, said acquiring being performed by the first
15 mobile access server;

transmitting a second message to the second mobile
access server in dependence upon said acquiring of the
address of the second mobile access server, the second
message including an address of the first mobile access
20 server and an Internet protocol of the mobile node; and

routing data from the mobile node through the
address of the second mobile access server acquired by
the first mobile access server.

25 14. The method of claim 13, wherein the address of
the first mobile node included in the first message is a
medium access control address.

15. The method of claim 14, wherein the first
30 subnetwork corresponds to a home subnetwork for the
mobile node and the second subnetwork corresponds to a
foreign subnetwork for the mobile node.

16. An apparatus for mobile communication, the
35 apparatus comprising:

a first subnetwork being in a wireless local area network, being in communication with the Internet, and being assigned a first Internet protocol address;
a second subnetwork being in the wireless local area network, being in communication with the Internet, and being assigned a second Internet protocol address different from the first Internet protocol address;
a foreign mobile access server being mounted in said second subnetwork, and broadcasting a first message including a medium access control address of a mobile node when the mobile node moves to said second subnetwork from said first subnetwork; and
a home mobile access server being mounted in said first subnetwork, acquiring an address of said foreign mobile access server from the first message, said home mobile access server transmitting a second message in response to the first message, the second message including an address of said home mobile access server and an Internet protocol address of the mobile node to said foreign mobile access server; wherein
said foreign mobile access server is arranged to route first data from the mobile node to the home mobile access server; and
said home mobile access server is arranged to route second data through the foreign mobile access server and then to the mobile node.

17. The apparatus of claim 16, wherein the routing of the first data from the mobile node to the home mobile access server is performed when the mobile node is in the second subnetwork.

18. The apparatus of claim 17, wherein the routing of the second data through the foreign mobile access

server and then to the mobile node is performed when the mobile node is in the second subnetwork.

19. The apparatus of claim 16, wherein the first
5 message is broadcast only when the mobile node is in communication with a second node when the mobile node is moved to said second subnetwork.

20. The apparatus of claim 19, wherein said home
10 mobile access server receives the second data from the second node, the first data being routed to the second node from said home mobile access server.

21. A method substantially as hereinbefore
15 described with reference to the accompanying drawings.

22. Apparatus constructed and arranged
substantially as hereinbefore described with reference to the accompanying drawings.



INVESTOR IN P.E.

Application No: GB 0304146.4
Claims searched: All

Examiner: Dr Jan Miasik
Date of search: 29 July 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1 - 7, 9 - 13, 16 - 20	WO 2002/017670 A1 (Nokia Corp.): see whole document, particularly p. 7, lines 14 - 35, p.8, lines 22 - 32, p. 16, lines 12 - 14, p. 17, lines 18 - 24 and the abstract
A		WO 2001/099457 A1 (Nokia Networks OY): see whole document

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC⁶:

H4L

Worldwide search of patent documents classified in the following areas of the IPC⁷:

H04L, H04Q

The following online and other databases have been used in the preparation of this search report:

Online: EPODOC, WPI, JAPIO